Space Weather Technical Forecast

Issued on Thursday, 22 February 2024 at 13:05 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Ongoing Moderate solar activity with a chance of X-class flares.

Solar Activity: Solar activity has been High, with an impulsive X1.8 flare peaking at 21/2307UTC from AR3590 in the northeast quadrant, and an X1.7 peaking at 22/0630UTC from the same region. AR3590 has shown significant development recently, with small delta spots forming in the central portion. AR3586 close to the north-centre disc is stable and simple. No further active regions are discernible on the visible disc, although returning region ex-AR3575 is just rotating around the southeast limb.

A large filament was observed leaving the northwest of the disc around 21/1730UTC and may give a glancing blow late on 24 Feb or early on 25 Feb. Another CME appeared to originate in the area around ex-AR3575, but has been analysed as missing Earth. Neither of the X-class flares appears to have produced a CME.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by ACE have been at ambient speed throughout, and density has been below average. Total magnetic field strength has been weak, at or below 8nT, with the north-south component varying weakly. Phi angle was firmly positive (away from the Sun). Geomagnetic activity was Quiet.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was just above normal background levels but well below the S1/Minor Radiation Storm threshold. Electron flux (greater than 2MeV) observed at GOES16 has been at normal background levels, with electron fluence well below the Active (1e8 integrated pfu) threshold. The observed 24-hour fluence at 22/0001UTC was 1.05e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is forecast with a chance of High activity, mainly from AR3590, but also potentially from ex-AR3575.

Solar Wind / Geomagnetic Activity: A filament was observed leaving the northwest of the disc around 21/1730UTC and may give a glancing blow late on 24 Feb or early on 25 Feb, otherwise there are currently no Earth-directed CMEs in the forecast. Solar winds are ambient, but may reach 450-500km/s either later on 24 or during 25 February due to a forecast connection with the high speed stream from coronal hole 01. Geomagnetic activity is forecast to be mainly Quiet with isolated Unsettled intervals. Active intervals are then considered possible due to the onset of the high speed stream on 24 and 25 February, with a slight chance of G1/Minor storm.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux is expected to continue at background levels or just above, but with a slight chance of an increase during this period due to energetic flares from AR3590.

High energy electron flux (greater than 2MeV) is expected to remain at normal background levels. 24-hour electron fluence is expected to stay below the Active (1e8 integrated pfu) threshold.

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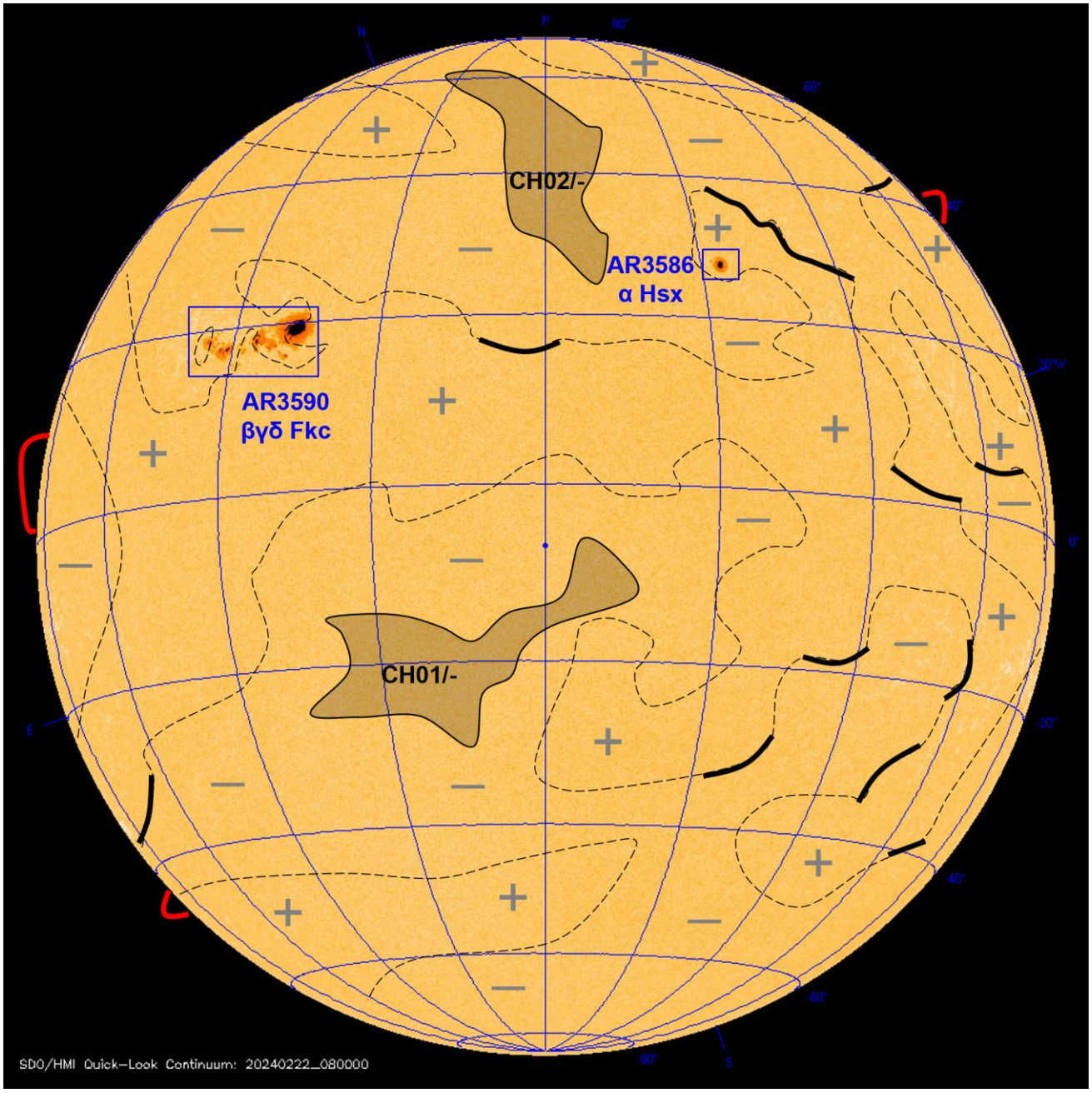
Figure 1. Solar Analysis Valid 22/0800UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A large filament was observed leaving the northwest of the disc around 21/1730UTC and may give a glancing blow late on 24 Feb or early on 25 Feb. Another CME appeared to originate in the area around ex-AR3575, but has been analysed as missing Earth. Neither of the X-class flares appears to have produced a CME.

A high speed stream from coronal hole 01 may connect with Earth either late on 24 or during 25 February. This feature reached close to 500km/s on the last rotation, but appears slightly smaller and weaker on this rotation so speeds of 450-500km/s are considered most likely. Geomagnetic response to this may be slightly stronger than last time as we are closer to the March equinox.

Geomagnetic activity is forecast to be mainly Quiet with isolated Unsettled intervals. Active intervals are then considered possible due to the onset of the high speed stream on 24 and 25 February, with a slight chance of G1/Minor storm, particularly if connection to the high speed stream and the glancing blow from the filament CME occur at similar times.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	10	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
22/0257	Partial	Filament eruption	Centre-W disc	425 km/s	25/0100UTC	Glancing blow possible

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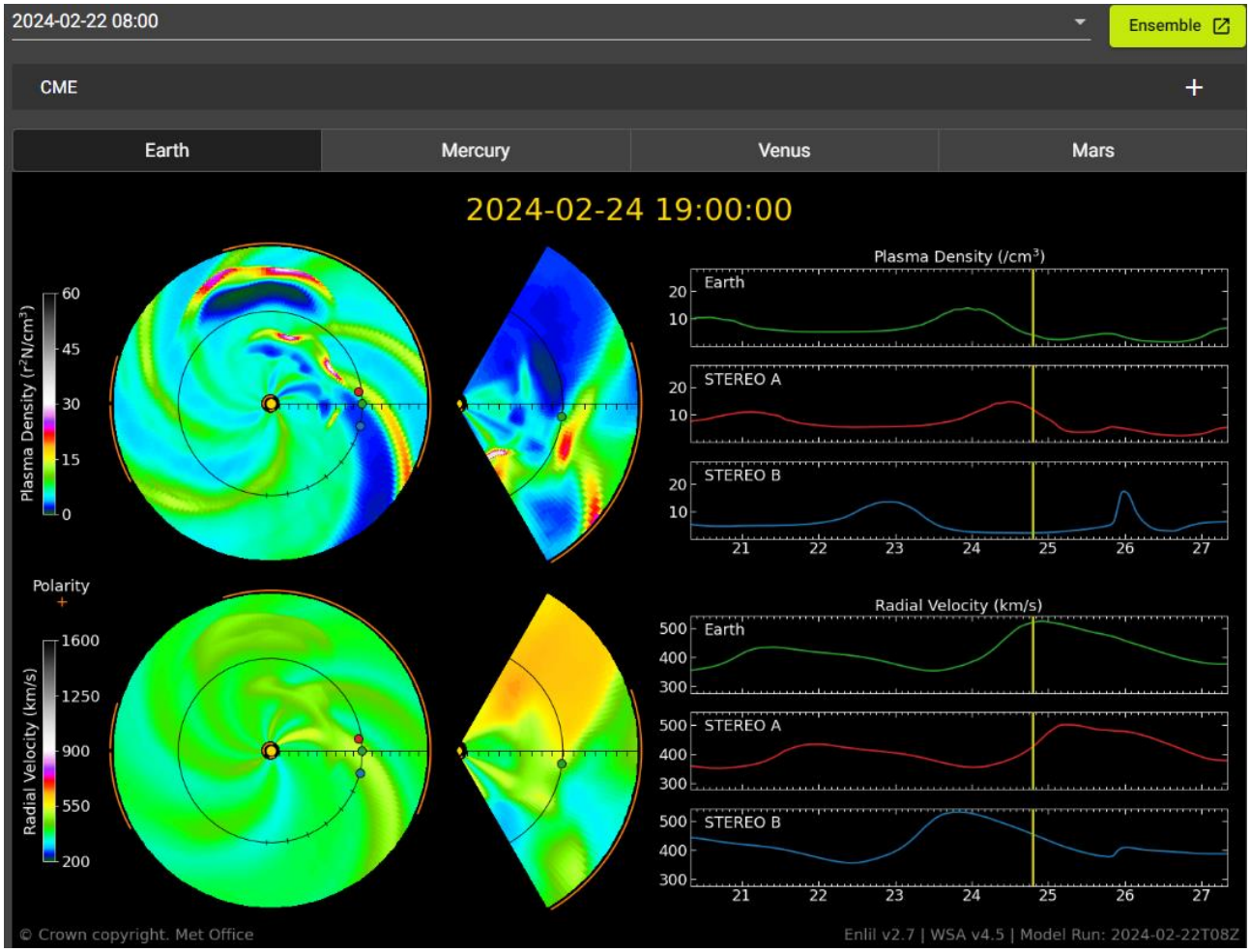
Figure 2: MOSWOC ENLIL 22/0800UTC run, showing influence of high speed stream



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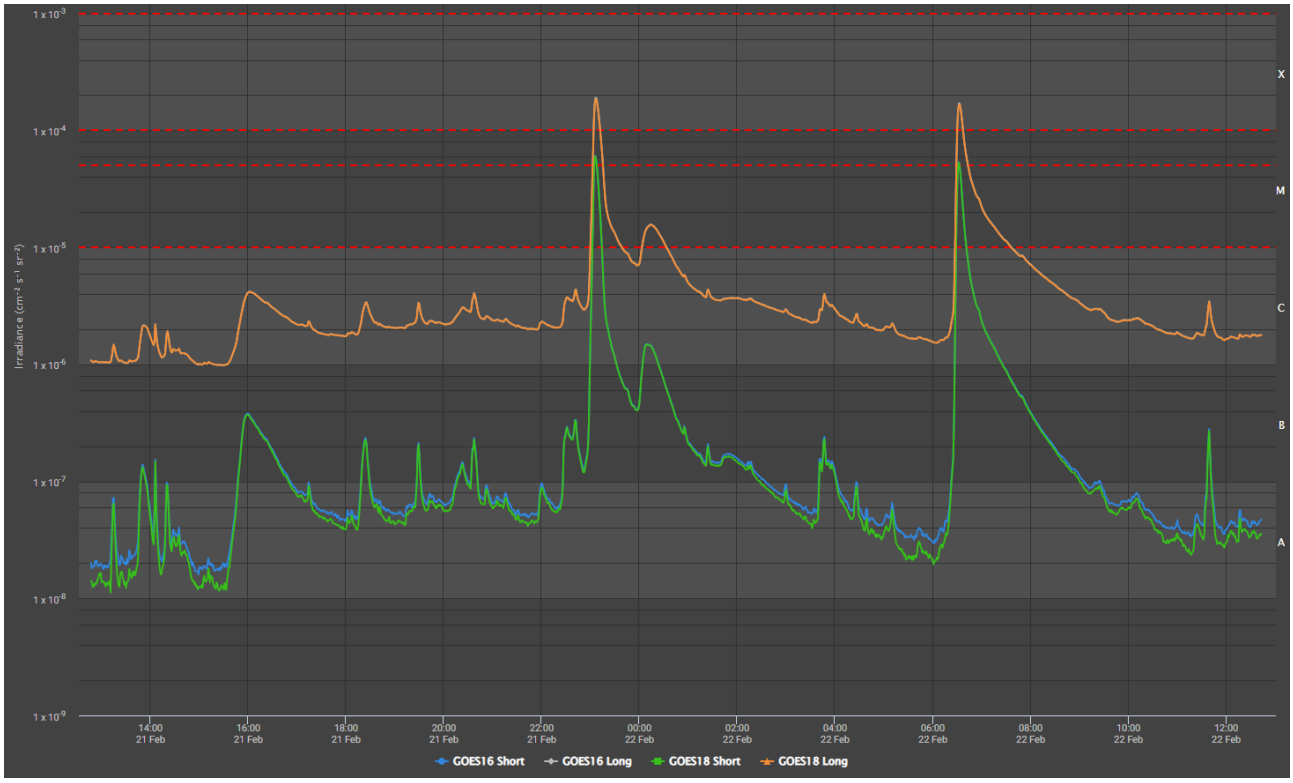
Radio Blackouts - X-Ray Flares:

Solar activity has been High, with an X1.8 flare at 21/2307UTC and an X1.7 at 22/0632UTC from AR3590. This region is still evolving in size and magnetic complexity, with several small delta spots recently developing. AR3586 is the only other region visible, but this is simple and stable. Ex-AR3575 is expected to return across the southeast limb through the next two days and has already exhibited significant activity on the far side, as well as an M1.5 flare at around 22/0015UTC, which produced a CME.

Activity is forecast to be mainly Moderate, with a chance of further X-class flares.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	60	60	60	60
Very Active	R3 to R5 X Class	Yes	20	20	20	20

Figure 3: GOES16/18 X-Ray Flares



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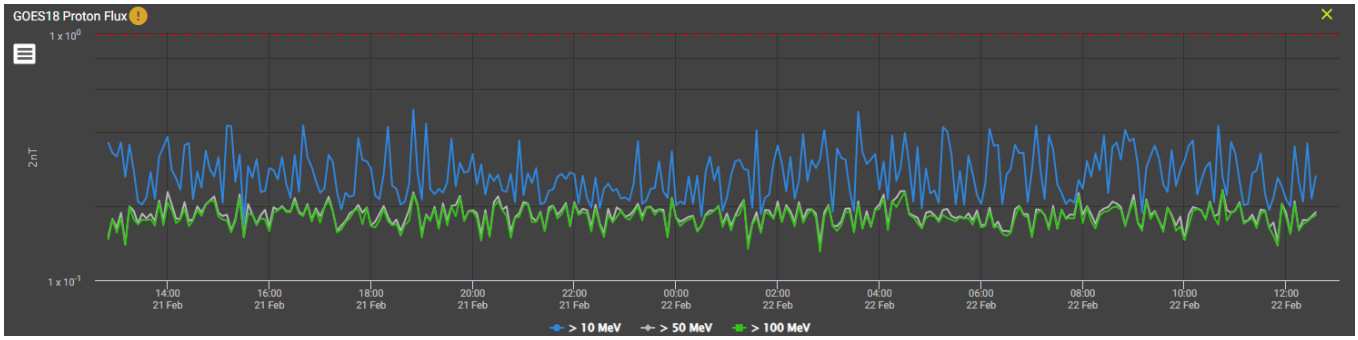
Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) protons have been slightly above background levels.

There are no significant sources of radiation storms in the western hemisphere, but AR3590 could be an increasing source of proton storms as the region moves towards and beyond centre disc through the forecast period. Ex-AR3575 is due to rotate onto the visible disc through the period and will present a risk of proton storms, albeit limited at first due to its position close to the southeast limb.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	15	15	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES18 Proton Flux



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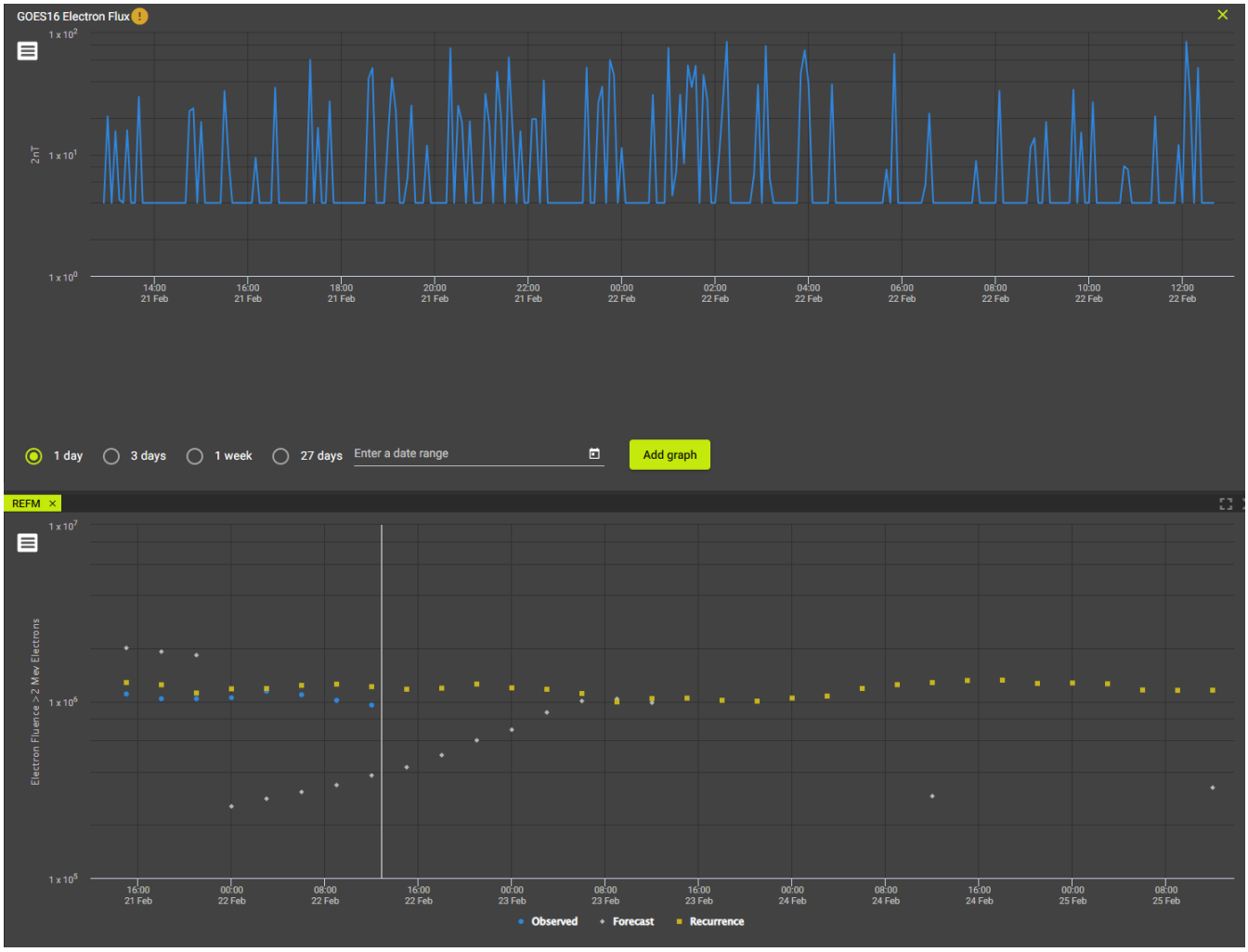
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is at background levels, with any enhancement from glancing CME blow or high speed stream on 24/25 Feb likely to be observed after this forecast period.

Electron fluence values are expected to remain well below the Active threshold during the forecast period.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: GOES16 Electron Flux (top) and MOSWOC REFM (bottom), thought to be giving good guidance.



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